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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/619,922	07/15/2003	Bing Ji	06437 USA	7155

23543 7590 09/06/2006

AIR PRODUCTS AND CHEMICALS, INC.  
PATENT DEPARTMENT  
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EXAMINER
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UMEZ ERONINI, LYNETTE T

ART UNIT	PAPER NUMBER
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1765

DATE MAILED: 09/06/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

10/619,922

Applicant(s)

JI ET AL.

Examiner

Lynette T. Umez-Eronini

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 03 August 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-11, 13 and 17-20 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 20 is/are allowed.
- 6) ☒ Claim(s) 1-11, 17, and 19 is/are rejected.
- 7) ☒ Claim(s) 13 is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_.
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date. \_\_\_\_\_.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_.

### **DETAILED ACTION**

This communication is in Response to Applicants' Remarks in Amendment filed 8/3/2006, in which previously Objected Claim 12 was written in independent form and Independent Claims 19 and 20 were indicated as being objected instead of being allowed. However, new art has been applied in the rejection of the claimed invention and a new Office Action is presented.

#### ***Claim Rejections - 35 USC § 103***

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 1, 2, 3, 5, 6, 8, 11, 17, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Isamu et al. (JP 2000-038581).

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Isamu teaches an etching gas that comprises:  $\text{CF}_3\text{OOCF}_3$  (same as Applicants' fluoroperoxide), [0004]. The etching gas further contains  $\text{CF}_4$  [0007], and may be mixed with an inert gas [0008]. The etching gas is also used for etching oxide [0006]. The aforementioned reads on,

A mixture for etching a dielectric material in a layered substrate, the mixture comprising:

a fluorocarbon; and

a fluorine-containing oxidizer selected from the group consisting of a hypofluorite, a fluoroperoxide, a fluorotrioxide, and combinations thereof, wherein the fluorine-containing oxidizer is a fluoroperoxide selected from the group consisting of difluoroperoxide, fluoro-trifluoromethyl-peroxide, bis-trifluoromethyl peroxide, pentafluoroethyl-trifluoromethyl-peroxide, bis-pentafluoroethyl-peroxide, difluorodioxirane, bis-trifluoromethyl peroxydicarbonate, fluoroformyl trifluoromethyl peroxide, bis-fluoroformyl-peroxide, and combinations thereof, **in claim 1**;

further comprising an inert diluent gas, **in claim 2**;

wherein the inert diluent gas is at least one selected from the group consisting of argon, neon, xenon, helium, nitrogen, krypton, and combinations thereof, **in claim 3**

wherein the fluorocarbon is at least one selected from the group consisting of perfluorocarbon, hydrofluorocarbon, oxyhydrofluorocarbon, oxyfluorocarbon, and combinations thereof, **in claim 5**;

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wherein the fluorocarbon is at least one perfluorocarbon selected from the group consisting of tetrafluoromethane, trifluoromethane, octafluorocyclobutane, octafluorocyclopentene, hexafluoro-1,3-butadiene, and combinations, **in claim 6**;

wherein the fluorocarbon is at least one hydrofluorocarbon, **in claim 8**;

wherein the fluorine-containing oxidizer is a hypofluorite having the formula  $C_xH_yF_z(OF)_nO_m$  wherein x is a number ranging from 0 to 8, y is a number ranging from 0 to 17, z is a number ranging from 0 to 17, n is 1 or 2, and m is 0, 1, or 2, **in claim 11**;  
and

wherein the dielectric material is at least one selected from the group consisting of silicon, silicon-containing compositions, silicon dioxide ( $SiO_2$ ), undoped silicon glass (USG), doped silica glass, silicon and nitrogen containing materials, organosilicate glass (OSG), organofluoro-silicate glass (OFSG), low dielectric constant materials, polymeric materials, porous low dielectric constant materials, and combinations thereof, **in claim 17**.

Isamu differs in failing to teach wherein a ratio by volume of the fluorine-containing oxidizer to the fluorocarbon is from 0.1:1 to 20:1, **in claim 1**.

However, Isamu illustrates the specific combination of a fluorocarbon and fluorine-containing oxidizer is known. As a result, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select any proportion (% by volume) fluorocarbon in the Isamu reference because such combination is known to effectively accomplish the disclosed composition in manufacturing semiconductor devices [0001].

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4. Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over Isamu (JP '581).

Isamu teaches a mixture for etching a dielectric material in a layered substrate comprising a fluorocarbon and a fluoroperoxide.

It is noted that Isamu is silent as Applicants' specifically claimed etchant mixture of a fluorocarbon and a fluoroperoxide.

However, it would have been obvious to one having ordinary skill in the art at the time the invention was made to employ any combination of etchant components as taught in the reference of Isamu, including Applicants' specifically claimed etchant mixture because such combination of etchant mixture is known to effectively accomplish the disclosed composition in manufacturing semiconductor devices [0001].

5. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Isamu (JP '581) as applied to claim 1 above, and further in view of Arleo et al. (US 5,176,790).

Isamu differs in failing to teach and wherein the mixture comprises from 0.1 to 99 % by volume of the inert diluent gas, **in claim 4**.

Arleo teaches etching mixtures comprising inert gases such as helium, neon, argon, krypton or xenon (column 3, lines 53-55) and may vary from 0 to 90 volume % of the total amount of gases in the mixture (column 4, lines 55-59).

Arleo illustrates inert gases are known. Hence, it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Isamu by selecting any of the known inert gases in the Arleo reference for the purpose of etching a via substantially without a taper (see Arleo, column 4, lines 62-64).

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6. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Isamu (JP '581) as applied to claim 1 above, and further in view of Liu et al. (US 6,403,491 B1).

Isamu differs in failing to teach the perfluorocarbon is hexafluoro-1,3-butadiene.

Liu teaches etching a dielectric layer using hexafluoro-1,3-butadiene (claims 1 and 30) and illustrates the said perfluorocarbon is known.

Hence, it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Isamu by employing Liu's hexafluoro-1, 3-butadiene for the purpose making via, self aligned contacts, dual damascene, and other dielectric etch (Liu, Abstract).

7. Claims 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Isamu (JP '581) as applied to claim 1 above, and further in view of Misra (US 6,242,359 B1).

Isamu differs in failing to teach wherein the fluorocarbon is at least one oxyhydrofluorocarbon, **in claim 9**; and wherein the oxyhydrofluorocarbon is at least one selected from the group consisting of perfluorocyclopentene oxide, hexafluorocyclobutanone, hexafluorodihydrofuran, hexafluorobutadiene epoxide, tetrafluorocyclobutanedione perfluorotetrahydrofuran ( $C_4F_8O$ ), hexafluoropropylene oxide ( $C_3F_6O$ ), perfluoromethylvinyl ether ( $C_3F_6O$ ), and combinations thereof, **in claim 10**.

Misra teaches etching dielectric film with hexafluoropropene oxide (same as applicants' oxyhydrofluorocarbons) compounds (column 3, line 65 – column 4, line 2). Exemplary compounds useful in the etching method include, but are not limited to

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hexafluoropropene oxide and perfluoromethylvinyl ether or combinations thereof (column 4, lines 64 - column 5, line 20).

Misra illustrates etching with an oxyhydrofluorocarbon is known. Hence, it would have been obvious to one having ordinary skill in the art at the time of the claimed invention to modify Isamu's etchant by using use an oxyhydrofluorocarbon as taught by Misra for the purpose of providing alternative to the conventionally used global – warming compounds for semiconductor etching processes (See Misra, column 4, lines 3-6).

#### ***Allowable Subject Matter***

8. Claim 13 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

9. The following is a statement of reasons for the indication of allowable subject matter:

As to claim 13, the prior art of record taken alone or in combination fails to suggest, teach or render obvious an etching mixture wherein the fluorine-containing oxidizer is a fluorotrioxide selected from the group consisting of bis-trifluoromethyl-trioxide, fluoro-trifluoromethyl-trioxide, fluoroformyl trifluoromethyl-trioxide, and combinations thereof.



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10. Claim 20 is allowed.

11. The following is an examiner's statement of reasons for allowance:

As to claim 20, the prior art of record taken alone or in combination fails to teach an etching mixture comprising: a fluorocarbon and a fluorotrioxide, along with the rest of the limitations of the claims.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

### ***Response to Arguments***

12. Applicants traverse with the rejection of claims 1, 2, 5, 6, 8, 11, 17, and 18 under 35 U.S.C. § 103(a) over Bigl (DD 145348); claims 3-4 over Bigl (DD '348) in view of (US 5,176,790); claim 7 over Bigl (DD '348) in view Liu et al. (US 6,403,491); and claims 9-10 over Bigl (DD '348) in view Misra (US 6,242,359). Applicants submit that the rejection is moot in view of the foregoing amendments (see Amendments, pages 2 of 7 to 7 of 7). Since new art discloses features of (Currently Amended) Claim 1, a new art rejection has been presented.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lynette T. Umez-Eronini whose telephone number is 571-272-1470. The examiner is normally unavailable on the First Friday.

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If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

ltue

August 21, 2006

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*Nadine Norton*  
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SPE 1765 - SUPERVISORY PAT. EXAMINER